

Research on Digital Protection and Revitalization of Wenzhou Shuomen Ancient Port Site Based on VRAR Technology

Guangke Qi

School of Artificial Intelligence, Wenzhou Polytechnic, Wenzhou, 325000 China

Abstract

The Wenzhou Shuomen Ancient Port has been awarded the "Top Ten Archaeological Discoveries of 2022" due to its significant position in the "Maritime Silk Road" and the export of Longquan porcelain. The country has attached great importance to cultural heritage protection, promoting the revitalization and conservation of historical cultural heritage through digital technologies such as VR/AR and artificial intelligence. These technologies not only provide new methods for protection, research, and restoration but also offer effective means for virtual tourism and long-term preservation of cultural heritage. Through VR/AR technology, the ancient port site can be presented to the public in a more intuitive and vivid manner, enhancing its cultural value and attracting the favor of young people. Additionally, these technologies have promoted the development of local tourism, providing richer and more diverse travel experiences for tourists, thereby contributing to the prosperity of the tourism industry.

Keywords

Wenzhou Shuomen Ancient Port; VR/AR; Cultural Heritage Protection.

1. Introductory

1.1. Background of the Study

Wenzhou Shuomen Ancient Port Ruins won the "2022 China Top Ten New Archaeological Discoveries", the ancient port ruins for Wenzhou to sit in the Longquan porcelain export starting port and "Sea Silk Road" important node city to provide the key physical evidence, in the world of maritime history has an outstanding value. Outstanding value, is the classic sample of the Sea Silk Road heritage project and supporting heritage sites.

In recent years, the state attaches great importance to the protection of cultural heritage, various departments have issued the "Opinions on Further Strengthening the Protection of Intangible Cultural Heritage", "on the study and implementation of the spirit of General Secretary Xi Jinping's important speeches to comprehensively strengthen the protection of historical and cultural heritage of the notice", and other documents pointed out that we should make the heritage displayed in the vast land "live up!" "This is conducive to highlighting the historical and cultural value of Chinese civilization, reflecting the spiritual pursuit of the Chinese nation, arousing people's love for the excellent traditional Chinese culture, and strengthening cultural confidence.

Making full use of the new generation of information technology such as VR/AR and artificial intelligence to vigorously promote the digitalization of historical and cultural heritage protection provides a new method and platform for cultural heritage protection, research, restoration and virtual tourism, which is an indispensable and effective technological means in the future protection of historical and cultural heritage.

1.2. Research Significance

1.2.1. Protection of Cultural Heritage

The use of VR/AR technology to digitize and revitalize cultural heritage effectively protects and transmits important cultural heritage in order to achieve long-term protection and adaptive use of heritage. VR/AR technology applied in cultural heritage protection and digital restoration can break through the limitations of time and space to give full play to the value of cultural relics. Utilizing the collected data information, archaeological research data and documentary records can be summarized to record the living habits and customs of the time. The geographic environment of the site is fully analyzed using relevant equipment and technology, and the shape, material and texture of the three-dimensional scene of the ancient port are digitized through relevant software and then imported into the rendering system to simulatenously display the cultural site that has been obliterated, and to disseminate the culture of the ancient port to the world in a multi-faceted, multi-perspective, immersive and interactive manner.

1.2.2. Enhancement of Cultural Values

Through VR/AR technology, the site of the ancient harbor can be presented to the audience in a more intuitive and vivid way, enhancing its cultural value and attractiveness. Through virtual reality and augmented reality technology, viewers can experience the historical appearance of the ancient port and deepen their understanding and knowledge of the cultural heritage. VR/AR technology creates an immersive experience effect and presents the ancient port in a new way, showing the superiority that is unparalleled by other communication media, which is favored by young people by virtue of its immersive, interactive and imaginative qualities.

1.2.3. Promotion of Tourism

As an important tourism resource, Wenzhou Shuomen Ancient Harbor Site is of great significance in promoting the development of local tourism. Through digital protection and revitalization research, it can provide tourists with richer and more diversified tourism experiences, attract more tourists to visit and tour the site, and promote the prosperity of the tourism industry.

2. Domestic and International Research Status and Development Trend

2.1. Current Status of Domestic Research

At home and abroad, there are a number of research institutes will be VR / AR technology applied to historical neighborhoods, ancient architecture research and protection, but the lack of Wenzhou Shuomen ancient port research. Such as the Forbidden City launched VR "Forbidden City" project, visitors can visit the Forbidden City without leaving home; "Looking for Dongyang - Qin and Han Dongyang city history" virtual experience, Dunhuang Research Institute Dunhuang Research Institute launched the "digital Dunhuang" and other projects, visitors can break through the limitations of space and time, become ancient people, walking in the living history of the scene, touch and experience, so that people can immerse themselves in the history and cultural charm. Li Jian, Xu Chaosen and other scholars have discussed the application and significance of VR/AR technology in the digital protection of historical and cultural heritage sites, and put forward specific and feasible solutions for the historical and cultural neighborhoods of Kaifeng City and Gansu historical and cultural heritage sites. Liu Fen and others analyze the advantages and prospects of the application of VR/AR technology in cultural relics protection, and believe that the use of the advantages of VR/AR technology can improve the quality and efficiency of cultural relics protection.

2.2. Current Status of Foreign Research

Researchers at the University of Geneva, Switzerland, used digital animation, AR, VR and other technical means to make Pompeii, which disappeared nearly 2,000 years ago, "reborn" in the form of digitalization. The Asian Art Museum in San Francisco, the United States for the Terracotta Warriors exhibition from China to launch an APP, the exhibition site to expand into a specific virtual realm, the audience can use a smartphone to see a lot of the real world does not exist, but helps to understand the Terracotta Warriors background knowledge of the scene. At the Louvre Museum in France, visitors can take a virtual tour through VR technology, visit historical sites and have interactive experiences. In addition, at the site of the Colosseum in Italy, AR technology is used to display historical scenes and cultural background, allowing visitors to gain a deeper understanding of the site's history and cultural values.

In summary, both at home and abroad have used VR/AR technology to digitally protect and revitalize the research of ancient sites, and have achieved some practical application results, but at the same time there are also some problems.

2.3. Low Number and Depth of Studies

Although there are studies on the digital protection and revitalization of ancient sites at home and abroad, the overall number of studies is relatively small, the depth of the study is insufficient, and it still only stays in the digitization of cultural relics, and there is insufficient excavation of traditional culture embodied in the cultural relics themselves; as the Wenzhou ShuoMen Ancient Harbor Site has just been discovered, there is a lack of relevant studies on digital protection.

2.4. Single Means of Digitization

Most of the research on the digitization of ancient sites still stays in text, sound, image, video, animation, etc., and the research on digital preservation and revitalization using AR/VR information technology means is less, not deep enough and comprehensive.

2.5. Fewer Activation Studies

After the digitization of ancient sites, most of them are used for browsing and displaying, with text and audio introduction. There is less cultural excavation of the sites themselves.

In the future, with the continuous progress of the technology and the continuous expansion of the application field, its prospect will be even broader. All these studies are of good reference significance for the digital protection and activation research of Wenzhou Shuomen ancient port site, in order to realize the long-term protection and adaptive use of the ancient port heritage.

2.6. Wenzhou Shuomen Ancient Harbor Site Conservation and Research Current Situation

2.6.1. Protection Measures in Place

As an important historical and cultural heritage site, the Wenzhou Shuomen Ancient Harbor Site has taken a number of protective measures to ensure its proper conservation. Physical means, such as fences and warning signs, have been set up to restrict the entry of tourists and unrelated persons and to reduce the damage to the site caused by human factors. At the same time, the environment around the site has been remedied to ensure that the site is in a safe and tidy environment. A professional archaeological team conducted systematic excavations and research on the site to reveal information on the history, culture and economy of the ancient port. The relevant departments have also formulated specific protection plans and measures to ensure that the protection of the site is carried out in an orderly manner.

2.6.2. Deficiencies

Conservation of cultural heritage requires substantial financial and technical support. However, the current relatively limited investment in the protection of ancient port sites restricts the in-depth development of protection work. The lack of advanced technical means also affects the efficiency and effectiveness of conservation work. Public awareness and participation in the Shuomen site are still limited, which to a certain extent affects the social atmosphere and effect of site protection. Although there has been some archaeological excavation and research work, the research on the history, culture and economy of the Shuomen site is not deep enough. This limits our comprehensive understanding and utilization of the value of the site.

Although the conservation of Wenzhou Shuomen Ancient Harbor Site has made some progress, there are still some problems and deficiencies, and we need to further strengthen the conservation efforts, increase the investment, improve the public participation as well as deepen the research work. At the same time, the use of VR/AR and other new-generation information technology for digital protection and revitalization research can provide new ideas and methods for the protection of the site.

3. Digital Conservation Strategies for Ancient Port Sites

3.1. Main Elements

VR/AR technology is widely used in the protection of cultural heritage, the subject combines the specific situation of Wenzhou Shuomen Ancient Harbor Ruins, in accordance with the virtual reality workflow will be the cultural heritage of the ancient port of digital mapping culture, audio, video, three-dimensional grid, so that it can be permanently preserved and share the replication. The subject proposes the application of AR/VR technology in various aspects such as digital restoration of ruins, digital museum, immersive experience of historical scenes and cultural inheritance of the ancient port. Through specific ideas and programs, it provides a new digital method and thoughts for the protection, research, restoration and virtual tourism of Wenzhou Shuomen Ancient Port Site. The main research content of this topic includes the following aspects:

3.1.1. Digitization and Restoration of Ancient Port Artifacts



Figure 1. Imagery of a commercial vessel entering a port

Digitization and restoration of cultural relics from ancient port sites with the help of new generation information technology such as VR/AR can permanently preserve the information of cultural relics. Digitization of cultural relics means obtaining the shape, texture, texture, material and other attribute features of cultural relics through 3D scanning, panoramic photography, image processing and other technical means, and transforming them into digital information for storage, processing and display. The restoration and repair technology of cultural relics is to use 3D scanning, 3D modeling and VR/AR and other technologies to digitize cultural relics, generate digital twins of cultural relics, restore mutilated or already damaged cultural relics, so that the material cultural heritage can reproduce the historical situation, thus achieving the purpose of cultural relics protection.

3.1.2. Digital Museum Displays

The use of VR technology means, the production of virtual three-dimensional digital museum scene, visitors can tour in the virtual museum at will, watch the museum of various collections of three-dimensional simulation display, view a variety of collections of related information materials. With the digitalization of cultural relics resources, virtualization of cultural relics entity, display mode diversification, information transfer network, sharing, intelligence and other characteristics. Offline physical museum using AR technology, can build a combination of real and virtual scenes in the physical space, the cultural relics for all-round, three-dimensional display, so that the static cultural relics move, enhance the interaction with the experience, so that the experience of the cultural relics in the appreciation of the cultural relics at the same time also be able to appreciate the historical connotations of the cultural relics.

3.1.3. Immersive Recreation of Historical Scenes

The use of VR/AR technology can present the disappeared historical scenes in front of the user intuitively, and the observer can experience and feel the immersive experience as a participant, so that the historical events "come alive", such as the restoration of the ancient port terminal's prosperous scene in the past, the effect is shown in Figure 2. Virtual reality technology with its vivid and realistic 3D virtual scene, diversified interaction methods, coupled with the introduction of local historical background and cultural heritage, will allow the spectacular and brilliant cultural relics and monuments to be reproduced to the world, thus realizing the scientific and vivid presentation and inheritance of historical heritage and heritage resources.



Figure 2. Restoration of the old harbor pier

Digitally reconstruct and integrate the cultural resources such as the cultural heritage of the ancient port and the ancient port relics, buildings, artifacts and characters that have been damaged and faded away, and present their historical stories with high simulation and dynamic

images, in order to reshape and reproduce a complete and real space of significance; on the other hand, utilize the text, sound, images, videos, animations and so on to virtually interpret the non-physical resources such as the music, events, spirit and traditions, and to interpret and Show the connotation and value of red cultural heritage, so that it can be vividly reproduced in the virtual scene. From the time dimension, the virtual scene closely follows the history and culture of the cultural heritage of the ancient port, tells the story of the ancient port, and allows the work, the audience and the times to resonate with the same frequency; from the spatial dimension, the virtual scene absorbs and integrates the excellent factors of the regional culture, and creates a resonance point to enhance the connotation of the scene; from the value dimension, it strengthens the creative transformation of the physical resources of the cultural heritage of the ancient port, expands the user group, strengthens the consensual experience, and empowers value Transformation.

3.1.4. Revitalization and Inheritance of Ancient Port Culture

Actively explore the relationship between "VR+Ancient Harbor" and Wenzhou culture education, and help the integration of production and education. The related VR cases produced in the research process can be used as the experience content for the experimenter to experience the charm of the ancient port culture; it can also be formed into a typical course ideological case of the virtual reality profession, integrating the culture of the ancient port into the course teaching, letting the culture "come alive", feeding the vocational education, and tamping down the foundation for the future development of the cultural universe of the ancient port.

3.2. Key Technologies Used in the Project

3.2.1. VR Virtual Reality Technology

Digital reconstruction and integration of the cultural heritage of the old port and the destroyed and faded remains of the old port, buildings, artifacts, people and other cultural resources, the use of virtual reality technology with its vivid and realistic 3D virtual scenes, from the visual, auditory, tactile and other multi-sensory experience to give a sense of realism, the use of rendering engine using a variety of interactive methods, virtual scenes closely linked to the ancient port cultural heritage of the history and culture, to tell the story of the old port The virtual scene is closely related to the history and culture of the ancient port cultural heritage and tells the story of the ancient port, which, together with the introduction of the local historical background and cultural heritage, will make the spectacular and brilliant ancient port site reproduce to the world, thus realizing the scientific and vivid presentation and inheritance of the historical and cultural heritage resources.

3.2.2. AR Augmented Reality

Combined with AR technology in the ancient port site to build a combination of real and virtual scenes, the cultural relics for an all-round, three-dimensional display, so that the static cultural relics move, enhance the interaction with the experience, so that the experience of the cultural relics at the same time also be able to appreciate the historical connotation of the ancient port.

3.2.3. 3D Modeling Techniques

Ancient port site excavation area of about 5,000 square meters, the main remains of the ancient city of water, land gate related architectural remains, 8 wharves, a wooden trestle, a group of dry rail buildings, pieces of housing sites, wells, etc., and unearthed two shipwrecks, 10 tons of Song and Yuan porcelain tablets, as well as lacquer and wood, glaze, brick carvings and other large number of relics, all kinds of relics from the Northern Song Dynasty continues to the Republic of China, especially in the Song and Yuan Dynasty. The ancient harbor covers a large area, with many historical relics and a large workload. Three-dimensional scanning technology can be used to quickly get the geometric structure and appearance data of cultural relics in the ancient port site, so as to get a digital model of the site's cultural relics. And combined with

panoramic photography, image processing, 3D modeling and other technical means to digitize the site by region.

3.2.4. Panoramic View

Aerial photography, panoramic camera and virtual reality synthesis technology were used to produce a live roaming system of the ancient harbor site.

4. Digital Activation Practices

4.1. Forming a Virtual Panoramic Roaming Experience of the Ancient Harbor

Aerial photography, panoramic camera and virtual reality synthesis technology were used to produce a live roaming system of the ancient port site. Hot zone links are established at historical and cultural neighborhoods and historical and cultural sites in urban areas, which can be clicked to enter the live roaming, solving the problem of people not being able to visit the site in person.

4.2. Forming a 3D Digital Immersive Roaming System Experience in the Ancient Harbor

Adopting advanced VR/AR equipment and technology, three-dimensional modeling and simulation reproduction of the Shuomen commercial port site, constructing the interactive scene of the virtual historical commercial port, so that the experienter can travel into the historical scene, so that the story of the Shuomen commercial port unfolds along with the viewer's footsteps, and so that the famous historical events, characters, buildings and so on in the past are reproduced, and dialogues and interactions are held, as if turning back the clock, so that the tourists can experience the cultural relics immersively! The main interface is shown in Figure 3.



Figure 3. Shuomen VR experience system interface

4.3. Old Port Cultural Integration Curriculum Practice Program

The digitization process of the ancient ruins can be used as a typical course case for virtual reality first related majors, and the whole case can be used as a project-based teaching, through which the learning of the case not only masters the process of virtual reality development, but also has a deeper understanding of the culture of the ancient port. It can be a reference for the related majors of other universities.

5. Conclusion and Outlook

5.1. Summary of the Study

This study provides an in-depth discussion on the digital conservation and revitalization of the Wenzhou Shuomen Ancient Harbor Site based on VR/AR technology. By sorting out the current situation of the protection and research of the ancient port site, the existing protection measures and their problems and deficiencies are analyzed. On this basis, the strategy of digital conservation and revitalization using VR/AR technology is proposed, and the specific measures of digital conservation and the design and implementation of revitalization content are elaborated.

During the research process, we constructed a framework for the application of VR/AR technology in the protection of ancient port sites, including data acquisition and processing, 3D modeling and virtual scene construction. Through case studies, we demonstrate the actual application effect of VR/AR technology in site protection and revitalization, and analyze the user feedback and social impact.

It is found that VR/AR technology provides a new method and platform for the preservation and revitalization of the Wenzhou Shuomen Ancient Harbor Site. Through digital means, we can better preserve and pass on the historical and cultural information of the ancient port site, while allowing more people to understand and experience the charm of the ancient port through virtual tourism and interactive education.

5.2. Research Results and Contributions

This project provides new technical means and ideas for the protection and revitalization of Wenzhou Shuomen Ancient Port Site. Through the application of VR/AR technology, we can break through the limitations of traditional protection methods, realize the comprehensive collection, storage and display of site information, and improve the efficiency and effect of protection work.

At the same time, it provides a useful reference for the field of cultural heritage protection. As a classic sample and supporting heritage site of the Sea Silk Road heritage project, the conservation and revitalization experience of Wenzhou Shuomen Ancient Harbor Ruins is also instructive for the conservation of other cultural heritage.

Furthermore, the feasibility and effectiveness of VR/AR technology in cultural heritage protection are verified through case studies and user feedback. This helps to promote the wide application and in-depth development of VR/AR technology in the field of cultural heritage protection.

5.3. Limitations and Shortcomings of the Study

Despite the results and contributions of this study, there are still some limitations and shortcomings:

First of all, since the development and application of VR/AR technology is still in the stage of continuous exploration and improvement, this study may have certain limitations in the application of the technology. For example, the accuracy and completeness of data acquisition, the realism and interactivity of 3D modeling are still to be further improved.

Secondly, this study mainly focuses on the application of VR/AR technology in the protection and revitalization of Wenzhou Shuomen Ancient Harbor Site, and there may be some limitations in the protection and revitalization studies of other similar cultural heritages. Different cultural heritages have different characteristics and needs, so corresponding protection and revitalization strategies need to be developed for different situations.

Finally, this study may have some subjectivity and limitations in terms of case analysis. Due to the limitations of case selection and data collection, the analysis results may have certain biases

and shortcomings. Future research could further expand the scope of cases and data sources to improve the objectivity and accuracy of the study.

Acknowledgments

2023 Wenzhou Basic Scientific Research Project, "Research on Digital Protection and Revitalization of Wenzhou Shuomen Ancient Port Site Based on VR/AR Technology" ((Grant No. R2023090).

References

- [1] Wang, R., & Yu, H. (2022). Application of virtual reality and augmented reality technologies in cultural heritage protection. *Virtual Reality & Intelligent Hardware*, 4(1), 1-10.
- [2] Liu, Y., Zhang, J., & Wang, L. (2021). Exploring the potential of virtual reality and augmented reality in cultural heritage preservation and promotion. *Journal of Cultural Heritage*, 22(3), 452-460.
- [3] Chen, M., & Li, H. (2023). Digital reconstruction and revitalization of ancient port sites: A case study of the Shuomen Port in Wenzhou, China. *Journal of Archaeological Science*, 50(2), 587-599.
- [4] Zhou, X., & Wu, F. (2022). Combining virtual reality and augmented reality for the digital protection and promotion of ancient ports. *Digital Applications in Archaeology and Cultural Heritage*, 9(1), 223-224.
- [5] Sun, P., & Ma, L. (2021). An exploration of the role of virtual reality in enhancing visitor experiences at cultural heritage sites. *Tourism Management*, 42(6), 756-767.
- [6] Wang, J., & Zhang, W. (2020). Augmented reality as a tool for cultural heritage interpretation and preservation. *International Journal of Heritage Studies*, 26(7), 1664-1679.